FINAL REPORT
CONSENSUS QA/QC ACCEPTANCE STANDARDS
TASK S-31
OF THE
SHIP PRODUCIBILITY RESEARCH PROGRAM

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CONSENSUS QA/QC

ACCEPTANCE STANDARDS

Task S-31
of the
Ship Producibility Research Program
(BIW P.O. C-4472-H)

Performed by:

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For:

U.S. Maritime Administration
and
SNAME Panel SP-6

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CONTENTS

CHAPTER 1

INTRODUCTION

For years the U.S. commercial shipbuilding industry has tolerated minor and, in some cases, major disputes between shipyards, customers, and regulatory agencies over quality assurance/quality control (QA/QC) acceptance criteria. These disputes, large or small, serve the same purpose - to increase the cost of U.S. shipbuilding and extend delivery schedules. Most of these discrepancies have stemmed from gaps in communication between the affected parties. Phrases like ‘accepted marine practice-, ‘marine quality and others are common in shipbuilding specifications, but there is no industry - wide definition of such terms. Their meaning varies from one shipyard to another, from one customer to another, even within a single shipyard between ship designers, engineers and construction trades. The availability of industry-wide consensus standards for common areas of discrepancy may provide a solution to this problem.

CHAPTER 2

OBJECTIVE AND SCOPE

This project was designed to identify areas where the development of consistent quality assurance/quality Control (QA/QC) acceptance standards can benefit the U.S. commercial shipbuilding industry by reducing ship construction, overhaul, and repair costs and improving efficiency. The need for standards in this area may be the result of external experience (reaching agreement with customers and regulatory agencies) or internal experience (communicating requirements from shipyard design departments to waterfront personnel). Past experience has defined a need to examine various QA/QC acceptance criteria used in shipbuilding to determine current practice and establish in which areas the development of industry-Wide standards of performance is most needed.

This project is part of a much broader effort develop and implement a National Shipbuilding Standards Program under the direction of SNAME Panel SP-6 as part of the Ship Producibility Research Program.

This project was limited in scope to commercial shipbuilding, overhaul, and repair; Naval shipbuilding use not included. It was not intended to survey every shipyard involved in commercial shipbuilding, but rather to gain a representative cross-section consensus of the need for QA/QC acceptance criteria. This effort did not include the development of actual standards.

CHAPTER 3

METHODS

In order to meet the stated objectives, a survey of three different groups was conducted - U.S. shipyards, foreign shipyards, and allied industries. Different survey data sheets were prepared to canvass each of these groups. Copies of these data sheets may be found in the appendix of this report.

The survey of U.S. shipyards involved the 18 yards represented on SNAME panels SP-6 (Shipbuilding Standards and Specifications) and SP-8 (Industrial Engineering), since their participation on these panels was taken as an expression of interest in industry standards. The yards were canvassed by either mail or personal visits. The survey data sheet used for U.S. Shipyards contained a list of potential areas in which shipyards may have a desire for a consensus standards and also invited respondents to add to this list any additional areas of concern. For each item, the shipyard was asked for the source of the standard used, if any, a brief description of it, and a priority ranking of the urgency for its development. The same basic data sheets were used for both mail responses and personal interviews. The major objective of this survey was to determine what QA/QC acceptance standards are currently used in the U.S. shipbuilding industry and where there exists an apparent need for the development of a consensus standard. Of the 18 yards contacted during this survey, ten elected to respond by furnishing information, a 55% response rate.

The survey of six foreign shipyards was conducted by canvassing their U.S. representatives. The object of this survey was to determine what areas of shipbuilding are governed by QA/QC acceptance standards in foreign yards and, if possible, to obtain a brief description of the standards used for comparison to any U.S. equivalent. The U.S. representatives were contacted due to the potential difficulties anticipated in surveying the overseas shipyards directly. Most foreign yards have representatives located in the New York City area. However, all of the offices were found to be very small and staffed with only one or two marketing personnel. In most cases, they sent the survey data sheets overseas to their home office for reply. Response from the foreign yards was poor. Of the six yards contacted, only one was able to furnish us with information on their QA/QC acceptance standards practices. The remainder elected not to reply at all, found the information too proprietary to release, or required payment for completing the data sheet.

Also surveyed were six companies functionally allied to the shipbuilding industry. These included companies engaged in the

fabrication of large, steel, welded, and coated structures for commercial clients, such as offshore structures, heavy equipment and cranes. Survey data sheets for this group solicited a brief description of any existing standard which applied to items a a given list of applications. The object of this survey was to determine the areas governed by QA/QC acceptance standards in similar industries and to compare those standards used to any existing shipbuilding standards in use. Of the six companies contacted, two replied but were limited in their response by the proprietary nature of the information requested.

CHAPTER 4

LIMITATIONS

As with most projects of this type, there are certain limitations which must be borne in mind when using the information presented. The first is that the subject of standardization is a very subjective issue with many people involved in shipbuilding. Thus, the response to a survey such as this may vary considerably from person to person, even within a single shipyard department. Some persons steadfastly resist any type of regulation of their activity, while others prefer to have standard measures of performance to go by. Respondents at some yards did not seem to be aware of the standardization effort involving U.S. shipyards and therefore were not aware of the possible benefits to be derived.

The ability of the respondent to answer for all areas of shipbuilding may also be a limitation in some cases. QA/QC organizations with U.S. yards vary considerably. Some yards have no QA/QC department, per se, but instead conduct QA/QC functions within each individual trade department. Others strictly regulate QA/QC from a single office. Still others function with a combination of the two. This has an effect on survey responses, because in many cases the respondent was not cognizant of the QA/QC criteria used within all the functional areas addressed by the survey data sheet. Due to time and availability constraints, it was not usually possible to interview or distribute survey forms to personnel directly involved in each of these areas. Therefore, many yard responses do not address every item on the survey data sheet.

Another limitation to be considered in using the results of this survey is that many yards categorize in-house QA/QC acceptance standards as proprietary information and are restrictive of its release to the public. Therefore, most yards were reluctant to release the details of internal standards, although all yards freely responded to their need for an industry standard in the areas addressed by the survey data sheet.

The last limitation to this survey concerns the responses made by shipyards. It is possible that over the years a person may use the same standard, but lose track of its origin. This may result, for instance, in reporting that a USCG standard is being used for a certain item when in fact the standard should be credited to the ABS.

CHAPTER 5

SURVEY RESULTS - U.S. SHIPBUILDERS

As noted in a previous section, the objective of the survey of U.S. shipbuilders was two-fold; the first was to determine what QA/QC acceptance standards are currently being used in the commercial shipbuilding industry; the second was to determine in which areas there exists a consensus need for the development of a QA/QC acceptance standard. The survey data sheets distributed to U.S. yards were designed to meet both of these objectives.

5.1 QA/QC Acceptance Standards Currently In Use

Table 5.1 is a compilation of responses to the source and description sections of the survey data sheet. This compilation is presented in a format corresponding directly to that of the original survey data sheet. The following terminology was used on the survey data sheet and will be used in presenting the results here also. The source of a standard is broken down into four categories - Internal, External, Other, and None. “Internal standards” are those that are developed within a shipyard itself for its own use. “External standards” are those developed by outside agencies, such as the American Bureau of Shipping (ABS), the U.S. Coast Guard (USCG), the National Association of Corrosion Engineers (NACE), or the American Society for Testing and Materials (ASTM), and are available to all yards. Those standards considered as “Other” are from ship owners, manufacturers~ and vendors. “None” means that no formal standard of any kind is now being used.

5.2 Consensus Need for QA/QC Acceptance Standards

For each of the items listed on the survey data sheet for U.S. shipyards the respondent was asked to indicate his yard’s need for an industry-wide QA/QC acceptance standard. The four options available were high, medium, low, and none. High” meant that a standard in this area would be very important and have a high potential for benefit to the shipyard. “Medium” indicated that a standard would have medium importance and some discernible potential for use at that yard. “LOW” indicated only a minor potential for use at that shipyard and "None” meant that the respondent felt that the item in question should not be standardized. TO establish a consensus priority for the development of specific standards a numerical ranking was assigned to each response as follows:

High	10
Medium	6
Low	2
None	0

Lack of response by a shipyard to a particular item was also counted as “None”.

Total points for each item were then computed and the items were arranged in order of their respective totals. Priority boundaries were drawn to indicate the overall priority of developing a consensus acceptance standard in an area. Table 5.2 is the result of those tabulations.

TABLE 5.1

COMPILATION OF RESPONSES FROM SURVEY DATA SHEETS

SUBASSEMBLY FABRICATION AND ERECTION

1. Accuracy of subassembly overall dimensions	Seven shipyards control subassembly dimensions through internal drawings and accuracy. control guidelines. One reports using ABS rules and NAVSHIPS 0900-000-1000 “Fabrication, Welding and Inspection of Steel ships“. One yard reported that no formal standard was used, but that internal checks were made.
2. Accuracy of door and hatch dimensions	Of the yards responding to this item, five reported using internal drawings and procedures to control door and hatch dimensions. One of these used a combination of an internal inspection system and NAVSHIPS 0900-000-1000, NAVSEA 0900-LP060-4010, NAVSHIPS 0900-003-8000, and MIL-STD 278.
3. Alignment of butting plates	Six reported using internal drawings and procedures. In several cases, these were used on NAVSHIPS 0900-000-1000. Two yards use external standards, ABS rules and/or NAVSHIPS 0900-000-1000.
4. Angular distortion of welded joints	Five yards reported using internal standards, in several cases based on NAVSHIPS 0900-000-1000. Two use ABS, USCG, or NAVSHIPS 0900-000-1000 and one reported that it was up to the customers and usually varied depending on the area of the ship and the plate thicknesses involved. One used no standard.
5. Intercostal alignment at cruciform joints	Five yards use internal standards, in several cases based on NAVSHIPS 0900-000-1000. Use of ABS rules allowing the maximum thickness was reported by two yards and one yard uses no standard for this item.

6. Alignment of discontinuous member on opposite sides of through member	Internal standards are used by five shipyards. In several cases these were based on NAVSHIPS 0900-000-1000. One of the five stated that the maximum permissible deviation was ½ the thickness of the lighter member. Three reported using the external standards of the ABS.
7. Squareness	Six shipyards use internal standards to control squareness, two of which were based on NAVSHIPS 0900-000-1000. Three reported that no standard is used.
8. Unfairness of the bottom, side, deck and superstructure	Five yards use internal standards; one of these bases their standard on NAVSEA 0900-LP-60-4010 and two base theirs on NAVSHIPS 0900-000-1000. Two use external standards, one uses ABS and NAVSHIPS 0900-000-1000 and one uses 0900-LP-060-4010. One yard does not use a standard.
9. Straightness of shapes	Five yards report using internal standards. Of these, one is based on "good marine practice", one is based on NAVSHIPS 0900-000-1000 and one is based on NAVSHIPS 0900-000-1000, NAVSEA 0900-LP-060-4010, NAVSHIPS 0900-003-8000, and MIL STD. 278. One yard reports using the external standards set by the manufacturers' mill specs and two. have no standards for the straightness of shapes.
10. Surface condition	Internal standards are employed by four shipyards. One of these bases their standard on NAVSHIPS 0900-00-1000 and one based theirs on NAVSHIPS 0900-000-1000, NAVSEA 0900-LP-060-4010, NAVSHIPS 0900-003-8000 and Mil Std. 278. Three yards use the external standard of the ABS and one uses both an internal standard and the ABS external standard.

11. Other	Four shipyards were interested in standards other than those included in the Survey Data Sheet under this heading. One yard reported that it had an internal standard for bulkhead plumbness - maximum error of 3/16″ in a 10′ vertical run. Three other yards listed areas in which no standard currently exists - standard fixes for inserts, pipe penetrations, etc.; acceptance and repair criteria for plate/aminations; and standards for grinding and chipping.

COATINGS

1. Surface preparation	Four shipyards report using external standards for surface preparation. Two of these mention using Swedish pictorial standards and one mentioned SSPC standards. Six yards said they use manufacturers' recommendations and three have some type of internal standard. Most of the shipyards responding to this item used a combination of the above standards.
2. Coating thickness	Use of internal standards is reported by three yards. Seven shipyards report going by manufacturers instructions and one reports that no standard is used. Several of the yards use both internal standards as well as manufacturers instructions.
3. Coating failure	Two yards use owners specifications to measure coating failure and two use the manufacturers instructions. Three yards do not

3. Coating failure (Cont'd)	use a standard and one yard uses a combination of internal standards and, NACE, SNAME, ASTM/ SSPC and Federal Test Methods Standards criteria.
4. Other	Two shipyards had suggestions for coating standards which are not now available. One desired a cross reference for use in combining the application of paints from different manufacturers. The other mentioned application standards for coating including safety, fire, toxicity, environmental impact on land, sea, and air, and both initial and long-term cost.

WELDING

1. Undercut for butt welds and fillet welds	Butt Welds - Five shipyards reported using internal standard drawings or visual standards for butt weld undercut. Of these, one was based on NAVSHIPS 0900-000-1000. Four yards used the external ABS, USCG, and NAVSHIPS 1000 standard and two used a combination of internal and external standards. Fillet Welds - Same response as above except one yard used ABS rules for butt welds did not use them for fillet welds.
2. Weld dimensions	Thee yards use internal standards. One of these noted that for undersized welds, there is no tolerance while for oversize there is no restriction unless taken to extremes. One yard uses both internal standards and external

2. Weld dimensions (Cont'd)	standards by ABS. One uses ABS and NAVSHIPS 0900-000-1000 and one uses ABS only. One uses no standard.
3. Minimum distance from butt weld to butt weld and from butt weld to fillet weld	Three yards employ internal standards for both butt weld to butt weld and butt weld to fillet weld distances. One of these said theirs is derived from military specs. Two rely on the external standard of the ABS and one uses both internal standards and the ABS standard. Three yards had no standards regulating these dimensions.
4. Physical weld characteristics	Five shipyards use internal standards for physical weld characteristics. Of these one was noted as a visual acceptance standard and another one was an internal procedure developed by a committee after reviewing military and commercial standards. Three use the external standard provided by the ABS and one has no standard covering this area.
5. Edge preparation	Five yards make use of internal standards for edge preparation several of these being based on a review of military specs. External standards are used by four yards. Of these one uses ABS rules and NAVSHIPS 0900-000-1000 two use ABS rules only, and one uses rules by ABS and AWS (American Welding Society).
6. Weld gap for both butt and fillet welds	Five shipyards report the use of internal standards for the weld gap of both butt and fillet welds. Of these five, one is based on NAVSHIPS 0900-000-1000. Three shipyards report the use of

WELDING (Cont'd)

6. Weld gap, etc. (Cont'd)	internal standards; one uses ABS rules and NAVSHIPS 0900-000-1000, one uses ABS rules only, and one uses ABS and USCG rules.
7. Others	One respondent noted that they had no standard for NDT acceptance and interpretation. Another noted that they had no standard for the welding sequence on erection units

MAIN HULL DIMENSIONS

1. Length B.P.	Three shipyards report using internal standards. Two report using external standards - one uses ABS rules and the other uses owner's specifications. Two report that no standard is used.
2. Beam	Of the shipyards responding to this item, three use internal standards, two use external standards (1 ABS, 1 owner's specs) and two use no standard.
3. Depth	Of the shipyards responding to this item, three use internal standards, two use external standards (1 ABS, 1 owner's specs), and two use no standard.
4. Deadrise at midship	Five yards report using internal standards pertaining to the deadrise at midship. Two report that no standards are used and one reports using ABS rules.
5. Forebody rise	Internals QA/QC standards for forebody rise were reported by four shipyards. One reported the use of ABS rules and one had no standard.

MAIN HULL DIMENSIONS (Cont'd)

6. Afterbody	Four yards use internal standards for this item. Two use no standard and one uses ABS rules and USCG regulations.
7. Draft marks	Internal standards are used by five yards. One noted that+ 1/8" was used. External standards are used by four yards; one uses ABS rules and USCG regulations, one uses ABS rules only, and two use USCG regulations only.
8. Freeboard marks	Four yards use some type of internal standard and four used external standards, mostly ABS rules.
9. Other	No response received. .

MACHINERY

1. Gear contact	Most shipyards report using both external standards of the ABS and manufacturers or venders specs. Eight use the ABS rules and eight use the specifications of the manufacturer or vendor. One yard uses an internal test procedure.
2. Deck machinery speeds	Three shipyards make use of manufacturers' specifications for deck machinery. Three use USCG and/or ABS rules. Two have internal standards and one has no standard.
3. Other	One yard noted that a standard for shaft alignment and distribution of loads was not available.

PIPING

1. Cleanliness of fluid systems (extent of flushing)	Five shipyards report using internal standards for fluid system flushing. One reports using ABS, USCG (ASME) and military specs and four use standards set by owners or manufacturers. Three yards report using more than one of these standards.
2. Accuracy of piping placement (compared to plan dimensions)	Four shipyards use no standard. Two employ internal methods and three report using some other standard.
3. Other	One yard noted that a standard for pipe penetrations through structural members would be useful.

MISCELLANY

1. Staging socket removal	Tanks - Four yards use internal guidelines for the removal of staging socket. One relies on owners to dictate the practice and two reported that no standards were used, but that it was handled on a case by case basis. Engine Room - Four yards employ internal standards for staging sockets in this area. Two use no standard and one follows the ABS rules. Deck - Four yards use internal standards. Two use no standard and one relies on owners wishes. Living Spaces - Internal standards are used by four yards. No standard is used by three yards. Other - No response

MISCELLANY (Cont'd)

2. Lifting pad removal	**Tanks** - Three yards have internal standards for lifting pads in tanks. Three have no standard, but instead handle on a case by case basis. One yard follows owner requirements. Engine Room - Three yards reported using internal standards. Three use no standard, one reported using the ABS rules. Deck - Three yards have internal standards for the removal of lifting pads on deck. Three have no standard but act on a case by case basis and one follows owner's requirements. Living Spaces - Same response " as for deck, above. Other - One yard reported using an internalnal standard for lifting pads in void spaces.
3. Access for maintenance	One shipyard uses customer requirements supplemented by information from manufacturers. One uses both military and commercial standards. One uses "good marine practice" and considers drawing approval by the owner as acknowledgment of acceptance. One uses owner specifications. One relies on vendor information and one uses no standard.
4. Maneuvering speed of ship (rudder performance)	Five yards use ABS and/or USCG regulations. These yards have internal test procedures that pertain to this area and one refers solely to owner requirements.

MISCELLANY (Cont'd)

5.	Uniform shipboard testing program (dockside and sea trials)	Some type of internal program is used at five yards. Two use owner's specifications. One uses SNAME guidelines and two use ABS rules, USCG regulations, or military specifications.
6.	General quality specifications for yard	Internal program specifications are reported in use at three yards . ABS, USCG, MIL specs and owner requirements were used at one yard. One uses MIL-I-45208 and another uses owner's specifications. No standard program is used by one shipyard.

TABLE 5.2

QA/QC ACCEPTANCE STANDARDS
DEVELOPMENT PRIORITY

Priority	Rank	Survey Data Sheet No.	Title
HIGH	64	6.1	Cleanliness of fluid piping systems
	58	3.1 (a)	Undercut - butt welds
	56	304	Physical weld characteristics
	52	2.1	Surface preparation (for coating)
	50	1.6	Alignment of discontinuous members
	50	3.l(b)	Undercut - fillet weld
	50	1.3	Alignment of butting plates
MEDI	48	1.8(C)	Unfairness - deck
	48	2.2	Coating thickness
	48	3.3(a)	Min. dist. from butt weld to butt weld
	48	3.5	Edge preparation
	48	7.6	General quality program
	46	7.4	Maneuvering speed of ship - rudder performance
	44	3.3(b)	Min. dist. from butt weld to fillet weld
	44	1.8(b)	Unfairness - side
	44	1.5	Intercostal alignment
	44	3.2	Weld dimensions
	42	1.10	Surface condition (plates, shapes)

TABLE 5.2 (Cont'd)

Priority	Rank	Survey Data Sheet No.	Title
MEDIUM (Cont'd)	42	3.4(a)	Weld gap - butt weld
	40	1.8(d)	Unfairness - superstructure
	38	3.6(b)	Weld gap - fillet weld
	36	1.4	Angular distortion of welded joints
	34	1.8(a)	Unfairness - bottom
	32	1.9	Straightness of shapes
	32	2.3	Coating failure
	32	7.5	Uniform shipboard testing
	30	7.3	Maintenance access
	28	1.7	Squareness
LOW	26	4.1	Length B.P.
	26	4.2	Beam
	26	4.3	Depth
	26	4.4	Deadrise at midship
	26	4.5	Forebody rise
	26	4.6	Afterbody rise
	24	4.7	Draft marks
	24	4.8	Freeboard marks
	24	7.1(b)	Staging sockets - engine room
	23	1.1	Subassembly - overall dimensions
	20	7.2(b)	Lifting pads - engine room

Priority	Rank	Survey Data Sheet No.	Title
LOW (Cont'd)	20	1.2	Door and hatch dimensions
	20	7.1(C)	Staging sockets
	18	5.1	Gear contact
	18	7.l(a)	staging sockets
	18	7.l(d)	Staging sockets
	14	702(a)	Lifting pad
	14	7.2(c)	Lifting pad
	14	7.2(d)	Lifting pad
	12	6.2	Accuracy of piping placement
	12	5.2	Deck machinery speeds

CHAPTER 6

SURVEY RESULTS - FOREIGN SHIPBUILDERS

The object of the survey of foreign shipbuilders was to determine what areas of shipbuilding are subject to QA/QC acceptance standards in other countries and to obtain copies of standards for possible later use in development of U.S. consensus standards. As noted in Chapter 3, only one foreign shipbuilder furnished information for use in this project. That respondent was a large Japanese shipbuilder. General information and a list of the items covered by their quality standards follow.

The Japanese shipbuilding industry has established national standards (called Japanese Industrial Standards), industry-wide voluntary standards and in-house company standards. Many QA/QC acceptance standards are contained in the industry-wide voluntary standards called Japanese Shipbuilding Quality Standard (J.S.Q.S.). The J.S.Q.S. was first established in 1963 by the Ship Structure Committee of the Society of Naval Architects of Japan and last updatd in 1979. The standards are voluntary, but are followed by most shipyards to the extent their production equipment and techniques allow. Smaller yards are especially receptive to these standards because they often lack the time or money to develop their own. In addition to these industry-wide standards, many yards in Japan also develop their own in-house standards covering areas not addressed by J.S.Q.S. industry-wide standards. A copy of the Japanese Shipbuilding Quality Standards was furnished for use in this project to show what areas are governed by voluntary QA/QC acceptance standards and for use in any ensuing development of standards identified by this report.

Table 6.1 lists areas of shipbuilding covered by a voluntary industry-wide quality standard in Japan.

TABLE 6.1

AREAS OF SHIPBUILDING QUALITY STANDARDS IN JAPAN

MATERIAL	
Surface Flaws	Pit Grade of Pit
	Flaking Grade of Surface Flaking
Casting Steel	Defects
Lamination	Local lamination Severe lamination .
MARKING	
Cutting Line and Fitting Edge	General member “ Size and shape Corner angle Curvature Location of member and mark for Fitting Block marking Location of member for fitting to block
GAS CUTTING	
Roughness	Free edge Weld groove
Notch	Free edge Upper edge of sheer strake Strength deck Main longitudinal strength member Others
	Weld groove. Butt weld Fillet weld
Dimension	Straightness of Plate Edge Depth of groove Length of taper Size of member Edge preparation

FABRICATION

Flange Longitudinal	Breadth of flange Angle between flange and web Curvature or straightness in plane of flange Curvature or straightness in plane of web
Flange Bracket	Breadth of flange Angle between flange and web
Template for Bending	Template in box shape Location of plate edge Shape of curved surface Section Template Location of check line for leveling by sight Shape
Angles and Built-Up Plates	Stringer Angle Compared with angle gage Compared with template Frame and Longitudinal , Curvature Deviation from correct form Deviation in flange angle Deviation of face plate
Plates	Corrugated Bulkhead Depth of corrugation Breath of corrugation Corrugated Wall Pitch of corrugation Depth of corrugation Cylindrical Structures Diameter Curved Shell Plate Checkline Gap between shell plate and secion template
Line Heating Method	Maximum Heating Temperature on Surface Water cooling after heating Air cooling after heating Air cooling and water cooling

SUB-ASSEMBLY

Accuracy of Dimensions

Flat Plate Sub-Assembly
- Breadth
- Length
- Squareness
- Distortion
- Deviation of interior members from skin plating

Curred Plate Sub-Assembly
- Breadth of sub-assembly
- Length of sub-assembly
- Distortion
- Squareness
- Deviation of interiormembers from skin plating

Plate Block Sub-Assembly
- Breadth of each panel
- Length of each panel
- Squareness of each panel
- Distortion of each panel
- Distortion of interior members from skin plating
- Twist of sub-assembly
- Deviation of upper/lower panel from centerline or baseline
- Deviation of upper/lower pane from FR.L

Curved Plat Block Sub-Assembly
- Breadth of each panel
- Length of each panel
- Distortion of each panel
- Deviation of interior members from skin plating
- Twist of sub-assembly
- Deviation of upper/lower panel from centerline or baseline
- Deviation of upper lower panel from FR.L

Block Sub-Assembly Including Stern Frame.
- Distance between upper/lower gudgeon
- Distance between aft edge of boss and aft peak bulkhead
- Twist of sub-assembly
- Deviation of rudder from shaft centerline
- Others

SUB-ASSEMBLY (Cont'd)

Accuracy of Dimensions	Rudder Twist of rudder plate Others
	Main Engine Bed Flatness of top plate of engine bed Breadth and length of top plate Others

ACCURACY OF HUIL FORM

Principal Dimensions	Length Length between perpendiculars Length between aft perpendicular and forward bulkhead of engine room
	Breadth Mold breadth admiships
Definition of Hull Form	Flatness of Keel Deformation for the whole length Deformation for the distance between two adjacent bulkheads
	Cocking Up Cocking up of afterbody
	Rise of Floor Rise of floor amidships

RIVETING

Rivet Hole	Hole Diameter
	Countersunk Depth Inclination
	Faying Surface Contact Clearance
	Unfairness Through Holes Discrepancy
	Pitch Deviation from marking point

RIVETING (Cont'd)

Rivet Hole	Countersunk Head Edge height
	Point Deformation Overlap Point edge Edge height

WELDING

Shape of Bead	Height of reinforcement breadth of bead flank angle
	Undercut Buff weld Fillet weld
	Leg Length
	Distortion of Welded Joint Angular distortion of Welded joint
	Short Bead, Tack Welding Bead, Repair Welding Bead
Arc Strike	Higher tensile steel and Grade E mild steel
	Cast Steel

ALIGNMENT AND FINISHING

Minimum Distribution of Weld to Adjacent Weld or Rivet	Butt weld to buff weld
	Butt weld to fillet weld
Gap Between Members	Gap between plate and stiffening member
	Through piece and tight plate
Fitting Accuracy	Alignment of fillet joint
	Difference between the beam and frame
	Gap before welding Fillet weld Butt weld
	Alignment of butt joint

ALIGNMENT AND FINISHING (Cont'd)

Finishing Up the Traces of Temporary Pieces	Part to be good appearance
	Not necessary to be good appearance
Surface Defect	Part to be good appearance
	Not necessary to be good appearance
Staging Socket	Removal in tanks in engine room in hold exposed parts of shell, etc.
Lifting Bye Piece	Removal Tanks Engine Room Hold Exposed parts of shell, etc.
Treatment of Holes Made Erroneously	D<200mm D>200mm Serration, scallop, slot
Unfairness	Shell Plate Double bottom tank tope plate Bulkhead Strength deck Second deck Fore castle deck Super structure deck Cross deck House wall Interior member Floor and girder of double bottom

DEFORMATION

Miscellaneous	Distortion of girder and transverse
	Distortion of longitudinal transverse . frame beam and stiffener
	Distortion of H pillar between decks
	Distortion of cross-tie

DEFORMATION (Cont'd)

Miscellaneous (Cont'd)	Distortion of tripping bracket and small stiffener with web plate
	Distortion of face plate

MISCELLANEOUS

Painting for welded and riveted joint at tightness test or construction inspection	Sub-assembly and assembly welded joint
	Erection welded joint
	Riveted joint
Draft Mark	In regard to template
Freeboard Mark	In regard to template
Hatch Coaming	Principal dimensions Length Breadth Diff. of diagonal length
	Deformation of horizontal stiffener End coaming Side coaming Deformation per one meter
Opening of Entrance	Opening of steel door Breadth and height Sill height Deformation
	Opening of deck (through type) Breadth Length
	Opening of deck (not through type) Breadth Length

CHAPTER 7

SURVEY RESULTS - ALLIED INDUSTRIES

The object of this survey was to ascertain what QA/QC acceptance criteria are employed by companies in industries that are in some way allied to the shipbuilding industry. As noted in Chapter 3, responses were received from two such firms. One was a large offshore platform fabricator and the other was a large company engaged in the construction of heavy equipment primarily cranes and excavators.

The company involved in the offshore construction field does not have a department specifically devoted to quality assurance and control. The offshore industry mainly relies on two documents published by the American Petroleum Industry (API) for recommended fabrication practices. One of these documents covers the planning, design, and construction of fixed offshore platforms while the other covers specifications and standards for the fabrication of structural steel pipes which serve as the main component of most fixed platforms. Any QA/QC standards not contained in the API publications are set by the owner prior to the start of construction. Any deviation is put in writing and approved by the owner or owner's representative before construction begins. Inspection is usually conducted by a third party retained by the owner. Any disputes over quality may lead to arbitration between the yard and the owner. Ultimate resoltuion of conflicts is by the owner.

The heavy equipment manufacturer has an overall company guality policy and each of its individual plants have specific QA/QC acceptance criteria of their own which pertain to the processes and equipment of that location. Each plant has a Quality Control Officer in charge of QA/QC activities. A copy of the company's quality control instructions, and copies of engineering specifications for design, manufacturing/QA-QC requirements, special applications, and weld process and consumable welding qualification testing were forwarded for use in this project and any standards development to follow.

Most of the QA/QC acceptance criteria involved in the manufacture of cranes and excavators which can be related to shipbuilding lie in the welding area. All welded joints are classified as Class A, B, or C. Quality control documentation identifies permissible weld defects by class. In class "A" welds, only one type of defect is permitted. If two or more different defects are found, the joint must be redone. For class "B" and "C" welds, certain types of defects are permitted together. Tables are available to identify the allowable defects.

QA/QC acceptance criteria are used by this company for the following items:

WELDING

1. Transverse cracks in welds
2. Longitudinal cracks in welds'
3. Crater cracks in welds
4. Torn surface (damage from removal of temporary welds)
5. Chipping marks (damage to surface from chipping hammar or chisel)
6. Weld surface porosity
7. Crater pipe (unfilled capacity at end of weld pass)
8. Irregular width of weld
9. Sponginess
10. Poor restart
11. Undercut
12. Shrinkage groove
13. Excess convexity
14. Excess reinforcement
15. Weld metal collapse due to gravity
16. Incompletely filled groove
17. Asymmetrical fillet
18. Burn through
19. Misalignment of welded joint
20. Arc strike (damage to parent metal by striking arc) .
21. Spatter (particles of weld or electrode clinging to weld or parent metal)
22. Excess grinding (reduction of metal thickness)
23. Allowable gap before welding
24. Underrun of fillet welds
25. Reinforcement of butt welds
26. Weld convexity
27. Weld overlap (protrusion of weld metal beyond the bond at the fussion between weld metal and parent metal)
28. Weld profile
29. Gas packets on surface
30. Slag inclusions

OTHER

1. Overall dimension accuracy tolerance
2. Cleanliness of fluid systems

CHAPTER 8

ANALYSIS OF SURVEY RESULTS

Based on the response received from from U.S. shipbuilders, to our survey there does appear to be a consensus need for QA/QC acceptance standards for certain items. Most shipyards surveyed in person were very receptive to QA/QC acceptance standards and had several areas of particular concern. Several cited past instances concerning quality acceptance criteria which proved both expensive and time consuming. The most prevalent reasons for these problems were gaps in communication between the yard and other parties such as owners and regulatory agencies.

The amount of QA/QC standardization employed in U.S. shipyards ranged from one extreme to the other. Some shipyards employed no formal standards other than those strictly required by regulatory agencies and others had "developed a standard of some type for just about every item on the survey data sheet. Many used external standards to the extent they were available and compensated their limitations with internally developed standards for quality acceptance criteria.

Based on a compilation of survey results, the need for all QA/QC items included in the survey was rated as either high, medium, or low priority. The items identified as high or medium priority are worthy of development. Those found to be of low priority are the object of only marginal interest and, as such, should be considered for development only in the long term or not at all.

The general areas in which most yards were especially interested were welding and structural fabrication. Most reported that they needed standards in these areas more than any others. Five of the seven high priority items and 12 of the 21 medium priority items pertained to these areas.

Results from both the foreign shipbuilder and allied industry survey were disappointing with regard to the number of companies which replied, but the responses received should be of some help during the development of QA/QC acceptance standards. They can be used for comparison to existing standards during preliminary stages of development.

A program was recently developed to recommend a plan for standards development for the U.S. shipbuilding industry over the next decade. This project, contracted to IHI Marine Technology of New York, a division of Ishikawajima-Harima Heavy Industries Co., Ltd. of

Japan, resulted in a 1982 final report entitled “Recommended U.S. Shipbuilding Standards Program - Long Range Plan” (hereafter referred to as Long Range Plan in this report). This important document covers the entire standardization issue and is expected to serve as a guide to further standardization efforts in this country.

The consensus need for QA/QC standards which was found by this study agrees closely with the findings of IHI Marine Technologies background surveyed reported in the Long Range Plan. Their survey found a need to establish quality standards acceptable to inspection groups for areas in which the quality acceptance level is not clearly defined such as welding, structural fabrication, painting, surface preparation, etc. The report states that “by establishing these standards, shipbuilders, owners, vendor/suppliers, and regulatory bodies can use uniform criteria for accuracy acceptance which should result in improved productivity.”

Since the Long Range Plan has been adopted to direct the standardization efforts of the U.S. shipbuilding industry, it is desirable to coordinate any QA/QC acceptance standards development with this plan. Many of the high and medium priority standards identified by this report can be accomplished within the present standards framework if the development of QA/QC acceptance criteria is incorporated into each applicable Testing/Inspection and Accuracy Standard of the Long Range Plan. Table 8.1 shows the items which were found to be of high or medium development priority and We possible Long Range Plan Standard under which they could be developed.

Although a large number of the high and medium priority standards can be accomplished within the Long Range Plan, there are some important areas which remain unaddressed. The most important of these is welding. Ten of the high or medium priority QA/QC standards pertain to welding indicating an area of notable concern to U.S. shipbuilders. But, only two Testing/Inspection or Accuracy Standards address this area in the Long Range Plan, Mid-term Testing/Inspection Standard “Tolerance of Welding” and the Mid-term Accuracy Standard “Assembly of Butt Welding Joints”. Serious consideration should be given to the development of the welding acceptance standards which do not appear to be covered by these. They include:

1. Undercut - butt welds
2. Physical weld characteristics
3. Undercut - fillet welds
4. Minimum distance from butt weld to butt weld
5. Edge preparation
6. Minimum distance from butt weld to fillet weld
7. Weld gap - fillet weld
8. Angular distortion of welded joints

If these standards were developed all the items listed as high priority would be addressed and also a large portion of the medium priority items.

Remaining medium priority items not covered by the Long Range Plan or included in the welding standards listed above include, in order of their survey rank:

10 Unfairness - deck
2. General quality program
3. Maneuvering speed of ship - rudder performance
4. Unfairness - side
5. Surface condition (of plate steel)
6. Unfairness - superstructure
7. Unfairness - bottom
8. Straightness of shpaes
9. Coating failure
10. Uniform shipboard testing
11. Maintenance access

It should be noted that some debate is possible over which QA/QC standards can be covered by the Long Range Plan and which cannot because no definition of the scope of each Long Range Plan standard is available.

TABLE 8.1

COMPARISON OF QA/QC STANDARDS AND LONG RANGE PLAN

Priority	Item Title	Applicable Long Range Plan Standard
HIGH	Cleanliness of fluid piping	MT Testing/Inspection Std. for steam and exhaust piping, feedwater piping, EW piping, hot water piping, SW piping, bilge piping, ballast and water piping, F.O. piping, L.O. piping, cargo oil piping and hydraulic piping.
	Undercut - butt welds	
	Physical weld characteristics	
	Surface preparation	MT Testing/Inspection Std. for surface preparation
	Alignment of discontinuous members	MT Accuracy Std. for alignment and finishing
	Undercut-fillet weld	
	Alignment of butting plates	MT Accuracy Std. for alignment and finishing or MT Accuracy Std for assembly of butt welding joint.
MEDIUM	Unfairness - deck	
	Coating thickness	MT Inspection Std. for paint film thickness
	Min. distance from butt weld to butt weld	
	Edge preparation	

TABLE 8.1 (Cont'd)

Briority	Item Title	Applicable Long Range Plan Standard
MEDIUM (Cont'd)	General quality program	
	Maneuvering speed of ship rudder performance	
	Min. dist. from butt weld to fillet weld	
	Unfairness - side	
	Intercostal Alignment	
	Weld dimensions	MT Testing/Inspection Std. for Tolerance of Welding .
	Surface condition (of plates)	
	Weld gap - butt weld	MT Accuracy Std. for assembly of butt welding joint
	Unfairness - deck	
	Weld gap - fillet weld	
	Angular distortion of welded joints	
	Unfairness - bottom	
	Straightness of shapes	
	Coating failure	
	Uniform shipboard testing	
	Maintenance access	
	Squareness	MT Accuracy Std. for dimensions of sub-assembly

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS

- Based on the survey of U.S. shipbuilders, there is sufficient interest to justify the development of QA/QC acceptance standards.

- QA/QC acceptance criteria should be incorporated into applicable Testing/Inspection and Accuracy Standards as found in "Recommended U.S. Shipbuilding Standards Program - Long Range Plan" wherever possible. This is possible for a large number of QA/QC acceptance standards.

- One important area which is not adequately addressed by the "Long Range Plan" is welding. This is an area of high interest to u.S. shipyards. Serious consideration should be given to the development of the QA/QC acceptance standards which pertain to welding. "

- Development of other high and medium priority standards is justified. The ranking based on survey results can be used to establish an order for development as time and money permit. Those standards identified as being of low priority are of marginal interest to shipbuilders.

APPENDIX

MARAD SHIP PRODUCIBILITY RESEARCH PROJECT

QA/QC ACCEPTANCE STANDARDS

SURVEY DATA SHEET

INSTRUCTIONS

This Survey Data Sheet 1s to be used In Identifying the QA/QCacceptance standards currently In use by the U.S. shipbuilding industry and for determining the areas In which the development of standards Is needed. Legible handwritten responses are fine. Following are instructions for completing the four major categories of this Survey Data Sheet.

1. **QA/QCAcceptance Item**

   This column lists functional areas and specific QA/QC acceptance items. However, the project Is by no means limited to the items listed here. Please feel free to include any other areas in which you have QA/QC acceptance standards or in which you would like to see a standard developed. Use the reverse side if necessary.

2. **Standard Currently Used - Source**

   Indicate the source of the standard currently being used by circling one of the following:

   Internal Standard (e.g. generated in-house)

   External Standard (e.g. developed by USCG, ABS, SNAME, etc.)

   Other source (e.g. dictated by owners)

   b formal standard now being used.

3. **Standard Currently Used - Description**

   For internal standard include a brief description (e.g. tolerance, applicability, etc.) and Indicate whether it would be available for industry review and possible adoption. For external standard, identify title, number., applicability, etc. if other is circled, please Indicate source of the standard and include a brief description (e.g. tolerance, applicability, etc.).

4. **Need for Industry-Wide Standard**

   Indicate your opinion of the need for development of an industry-wide standard by circling one of the following:

   Highly important

   Medium importance

   Low importance

   No need for a formal standard In this area.

Please fill in company name, your name and your phone number. We would like the opportunity to contact you at a later date for further clarification or information shouid it be necessary.

We appreciate your time and effort spent completing this form. Please send completed forms to:

Newport News Shipbuilding
ATTN: Mr. A. N. Titcomb, 033, Bldg. 600
4101 Washington Avenue
Newport News, Virginia 23607

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET

QA/QC AREA	QA/QC Acceptance Item		STANDARD CURRENTLY USED		Need for Ind. Wide Std.
			Source	Description	
1.0 SUB-ASSEMBLY FABRICATION AND ERECTION	1.1 Accuracy of sub-assembly overall dimensions		Int. Ext. Other None		High Med. Low None
	1.2 Accuracy of door and hatch dimensions		Int. Ext. Other None		High Med. Low None
	1.3 Alignment of Butting Plates		Int. Ext. Other None		High Med. Low None
	1.4 Angular Distortion of Welded Joints		Int. Ext. Other None		High Med. Low None
	1.5 Intercostal Alignment at Cruciform Joint		Int. Ext. Other None		High Med. Low None
	1.6 Alignment of discontinuous members on opp. sides of through member		Int. Ext. Other None		High Med. Low None
	1.7 Squareness		Int. Ext. Other None		High Med. Low None
	1.8 Unfairness	Bottom	Int. Ext. Other None		High Med. Low None
		Side	Int. Ext. Other None		High Med. Low None
		Deck	Int. Ext. Other None		High Med. Low None
		Super-structure	Int. Ext. Other None		High Med. Low None
	1.9 Straightness of shapes		Int. Ext. Other None		High Med. Low None

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC Acceptance Item		STANDARD CURRENTLY USED: Source	STANDARD CURRENTLY USED: Description	Need for Ind. Wide Std.
1.0 (Cont'd)	1.10 Surface condition [pitting, scars, etc.)		Int. Ext. Other		High Med. Low None
	1o11 Other:		Int. Ext. Other None		High Med. Low None
2.0 COATING	2.1 Surface preparation		Int. Ext. Other None		High Med. Low None
	2.2 coat i ng Thickness		Int. Ext. None		High Med. Low None
	2.3 coat i ng Fa i l Ure		Int. Ext. None		High Med. Low None
	2.4 Other:		Int. Ext. None		High Med. Low None
3.0 WELDING	3.1 Under-cut	Butt Weld	Int. Ext. None		High Med. Low None
		Fillet Weld	int. Ext. Other No		High Med. Low None
	3.2 Weld Dimensions		Int. Ext. None		High Med. Low None
	3.3 Min. Dist. from AdJ. Weld	Butt Weld to Butt Weld	Int. Ext. Other None		High Med. Low None
		Butt Weld to Fillet Weld	Int. Ext. None		High Med. Low None
	3.4 Physical Weld Charact. (rough-ness, porosity, profile, etc.)		Int. Ext. Other None		High Med. Low None

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC Acceptance Item		STANDARD CURRENTLY USED: Source	STANDARD CURRENTLY USED: Description	Need for Ind. Wide Std.
3.0 (Cont'd)	3.5 Edge Preparation		Int. Ext. None		High Med. Low None
	3.6 Weld	Butt Weld	Int. Ext. None		High Med. Low None
		Fillet Weld	Int. Ext. None		High Med. Low None
	3.7 other:		Int. Ext. Other None		High Med. Low None
4.0 MAIN HULL FORM DIMENSIONS	4.1 Length B.P.		Int. Ext. Other None		High Med. Low None
	4.2 Beam		Int. Ext. Other None		High Med. Low None
	4.3 Depth		Int. Ext. Other None		High Med. Low None
	4.4 Deadrise at Midship		Int. Ext. Other None		High Med. Low None
	4.5 Forebody Rise		int. other None		High Med. Low None
	4.6 Afterbody Rise		Int. other None		High Med. Low None
	4.7 Draft Marks		Int. other None		High Med. Low None
	4.8 Freeboard Marks		Int. Ext. None		High Med. Low None

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (cont'd)

QA/QC AREA	QA/QC Acceptance - Item		STANDARD CURRENTLY USED		Need for Ind. Wide Std.
			Source	Description	
Cont'd	4.9 Other:		Int. Ext. None		High Med. Low None
5.0 MACH	5.1 Gear Contact		int. Ext. Hone		High Mad. Low None
	Dk. Machty. Speeds (anchor windlass, mooring winch, etc.)		Int. None		High Med. Low None
	5.3 Other:		Int. Ext. None		High Med. Low None
6.0 PIPING	6.1 Cleanliness of fluid systems (extent of flushing)		Int. Ext. None		High Med. Low None
	6.2 Accuracy of piping placement (compared to plan dimensions)		Int. Ext. Other None		High Med. Low None
	6.3 Other		Int. Ext. None		High Med. Low None
7.0 MISCELLAN	7.1 Staging Socket Removal	Tanks	int. Ext. Other None		High Med. Low None
		Engine Room	int. Ext.		High Med. Low None
		Deck	Int Other None		High Med. Low None
		Living Space	int. other None		High Med. Low None
		Other:	int. other None		High Med. Low None

ACCEPTANCE STANDARDS- SURVEY DATA SHEET (Cont'd)

QA/QC Acceptance Item		STANDARD CURRENTLY USED		Need for Ind. Wide Std.
			Description	
7.2 Lifting Pad Removal	Tanks	int. Ext. None		High Med. Low None
	Engine Room	int. Ext. None		High Med. Low None
	Deck	int. Ext. Other None		High Med. Low None
	Living Spaces	int. Ext. Other None		High Med. Low None
	Other:	Int. EXT- None		High Med. Low None
7.3 Access for Maintenance		int. Ext. None		High Med. Low None
7.4 Maneuvering Speed Of Ship (rudder performance)		int. Ext. None		High Med. Low None
7.5 Uniform shipboard testing program (dockside and sea trials)		Int. Ext. None		High Med. Low None
7.6 General quality program specifications for yard		int. Ext. None	(Please include copy if possible)	High Med. Low Hone
8.0 Other		int. Ext. None	(Use reverse side if necessary)	High Med. Low None

Company Name _____

Respondant _____

Phone _____ Date _____

U.S. MARITIME ADMINISTRATION
SHIP PRODUCIBILITY RESEARCH PROJECT
QA/QC ACCEPTANCE STANDARDS
SURVEY DATA SHEET

INSTRUCTIONS

This Survey Data Sheet is to be used to identify QA/QC acceptance standards currently in use in foreign shipyards. The information will be used to determine the areas in which the development of standards is needed for the U.S. commercial shipbuilding industry. Legible handwritten responses are fine. Following are instructions for completing this Survey Data Sheet.

1. QA/QC Acceptance Item

This column lists specific QA/QC acceptance items for which we would like to determine existing standards. However, the project is not limited to the items listed here. Please feel free to include any other areas in which you have QA/QC acceptance standards. Use the reverse side of sheets if necessary.

2. Standard Currently Used - Description

Please identify the title and source of the standard for the areas listed in the previous column, the type of ship on which it is applicable, and a brief description of the standard tolerances, sizes, etc.

Please fill in company name, your name, and your phone number. We would like the opportunity to contact you at a later date for further clarification or information should it be necessary.

We appreciate your time and effort spent completing this form. Please send completed forms to:

Newport News Shipbuilding
ATTN : Mr. A. N. Titcomb, 033, Bldg. 600
4101 Washington Avenue
Newport News, Virginia 23607
USA

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET

QA/QC AR	QA/QC Acceptance Item		STANDARD CURRENTLY USED Description
AN ABR EM B-	1 1 Accuracy of sub-assembly overall dimensions		
	1.2 Accuracy of door and hatch dimensions		
	7 . 3 Alignment of Butting Plates		
	1.4 Angular Distortion of Weided Joints		
	Intercostal Alignment at cruciform Joint		
	1. 6 Alignment of dis-continuous members on opp. sides of through member		
	1 7 Squareness		
	Unfair-mess	Bottom	
		Side	
		Deck	
		Super-structure	
	7. 9 Straightness of shapes		

QA/QC ACCEPTANCE STANDARDS-SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC Acceptance Item		STANDARD CURRENTLY USED Description
1.0 (Cont'd)	1.10 Surface condition (pitting, scars, etc.)		
	1o11 Other:		
2.0 COATING	2.1 Surface preparation		
	2.2 Coating Thickness		
	2.3 Coating Failure		
	2.4 Other:		
3.0 WELDING	3.1 Under-cut	Butt Weld	
		Fillet Weld	
	3 . 2 Weld Dimensions		
	3.3 Min. Dist. from Adj . Weld	Butt Weld to Butt Weld	
		Butt Weld to Fillet Weld	
	3.4 Physical Weld Charact. (rough-ness, porosity, profile, etc.)		

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC Acceptance item		STANDARD CURRENTLY USED: Description
3.0 (Cont'd)	3.5 Edge preparation		
	3.6 Weld	Butt Weld	
		Fillet Weld	
	3.7 Other:		
4.0 MAIN HULL FORM DIMENSIONS	4.1 Length B.P.		
	4.2 Beam		
	4.3 Depth		
	4.4 Deadrise at Midship		
	4.5 Forebody Rise		
	4.6 Afterbody Rise		
	4.7 Draft Marks		
	4.8 Freeboard *Marks*		

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC acceptance item		STADARD CURRENTLY USED Description
4.0 (Cont'd)	4.9 Other:		
5.0 MACHINERY	5.1 Gear Contact		
	5.2 Dk. Mach'y. Speeds (anchor windlass, mooring winch, etc.)		
	5.3 Other:		
6.0 PIPING	6.1 Cleanllness of fiuid systems (extent of flushing)		
	6.2 Accuracy of plplng placement (compared to plan dimensions)		
	6.3 other		
7.0 MISCELLANY	7.1 Stag i ng Socket Remova l	Tanks	
		Engine Roan	
		Deck	
		Living Space	
		Other:	

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC Acceptance Item		STANDARD CURRENTLY USED Description
7.0 (Cont'd) 7.2 Lifting Pad Removal	Tanks	
	Engine Room	
	Deck	
	Living Spaces	
	Other:	
7.3 Access for Maintenance		
7.4 Maneuvering Speed of ship (rudder performance)		
7.5 uniform ship-board testing program (dock-side and sea trials)		
7.6 General quality program specifications for yard		(Please include copy if possible)
8.0 Other		(Use reverse side if necessary)

Company Name _____

Respondant _____

Phone _____ Date _____

U.S. MARITIME ADMINISTRATION
SHIP PRODUCIBILITY RESEARCH PROJECT
QA/QC ACCEPTANCE STANDARDS
SURVEY DATA SHEET

INSTRUCTIONS

This Survey Data Sheet is used to gather information on the QA/QC acceptance standards employed by industries allied to the U.S. commercial shipbuilding industry. These industries include those which are involved in the construction of large steel, welded structures for commercial clients. Following are instructions for completing this Survey Data Sheet. Legible handwritten responses are fine.

1. QA/QC Acceptance Item

This column lists functional areas and specific QA/QC acceptance items in which we are interested. Please feel free to include any other QA/QC acceptance areas which you feel may be of interest.

2. Standard Currently Used - Description

Please provide a concise description of the QA/QC standard whic;h you use for the particular item identified in the previous column. Include tolerances used, limits applicability etc. If the particular item is not relevent to your particular product, write "N.A." in the box. If you feel some explanation is necessary for a particular standard, please use the reverse side of the sheet. If you do not have a consistent standard for a particular item listed just write -- "None. "

Please fill in company name, product to which these standards apply, your name, and your phone number. We would like the opportunity to contact you at a later date for further clarification or information should it be necessary.

We appreciate your time and effort spent completing this form. Please send completed forms to:

Newport News Shipbuilding
ATTN : Mr. A. N. Titcomb, 033, Bldg. 600
4101 Washington Avenue
Newport News, Virginia 23607
USA

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET
OR ED NDUSTRIES

QA/QC AREA	QA/QC Acceptance Item	STANDARD CURRENTLY USED Description
1.0 FABRICATION AND EREC ION	1.1 Accuracy of sub-assembly overall dimensions	
	1.2 Accuracy of door and hatch dimensions	
	1.3 Alignment of Butting Plates	
	1.4 Angular Distortion of Welded Joints	
	1.5 intercostal Alignment at Cruciform Joint	
	1.6 Alignment of dis-continuous members on opp. sides of through *member*	
	1 . 7	
	1.8 Unfairness	
	1.9 Straightness of shapes	
	1 10 Surface condition (pitting, scars, etc.)	
	1.11 Other:	

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC Acceptance item		STANDARD CURRENTLY USED Description
2.0 COATING	2.1 Surface Preparation		
	2.2 Coating Thickness		
	2.3 coating Failure		
	2.4 Other:		
3.0 WELDING	3.1 Under-cut	Butt Weld	
		Fillet Weld	
	3.2 Weld Dimensions		
	Min. Dist. from Adj. Weld	Butt Weld to Butt Weld	
		Butt Weld to Fillet Weld	
	3.4 Physical Weld Charact. (roughness, porosity, profile, etc.)		
	3.5 Edge Preparation		

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

QA/QC AREA	QA/QC Acceptance Item		STANDARD CURRENTLY USED Descripition
3.0 (Cont'd)	3.6 Weld Gap	Butt Weld	
		Fillet Weld	
	3.7 Other:		
4.0 OVERALL DIMENSIONS	4.1 Length		
	4.2 Width		
	4.3 Depth		
	4.4 Other:		
5.0 MACHINERY	5.1 Gear Contact		
	5.2 Vibration		
	5.3 Other:		

QA/QC ACCEPTANCE STANDARDS - SURVEY DATA SHEET (Cont'd)

AREA	QA/QC Acceptance Item	STANDARD CURRENTLY USED Description
6.0 PIPING	6.1 Cleanliness of fluid systems *(extent of* flushing)	
	6.2 Accuracy of piping placement (compared to plan dimensions)	
	6.3 Other	
7.0 MISCELLANY	7.1 Staging Socket . Removal	
	7.2 Lifting Pad Removal	
	7.3 Access for Maintenance	
Other	8.0 other	(Use reverse Side if necessary)

Company Name _____

Product to which these standards apply _____

Respondant _____

Phone _____ Date _____